

Appl. No. 10/605,197
Amdt. dated December 8, 2004
Reply to Office action of September 08, 2004

AMENDMENTS TO THE CLAIMS

1. (currently amended) A regulated charge pump comprising:
- 5 a negative charge pump for generating a first output voltage
by determining an oscillation signal; [[and]]
a regulator for restricting a swing of the first output
voltage, the regulator comprising:
a level shift circuit connected to the negative charge
10 pump for generating a second output voltage at an
output end of the level shift circuit by determining
the first output voltage generated by the negative
charge pump, the level shift circuit comprising:
a plurality of serially connected PMOS transistors,
15 a first source of a first PMOS transistor of the
PMOS transistors connected to a first reference
voltage source, a first gate and a first drain
of the first PMOS transistor connected to the
output end of the level shift circuit, and a
20 second gate and a second drain of a second PMOS
transistor of the PMOS transistors connected to
the output end of the negative charge pump;
a differential amplifier, whose first and second
input ends are connected to a second reference
25 voltage source and the output end of the level
shift circuit respectively, for generating a
compare signal by determining a voltage
difference between the second output voltage and
a voltage generated by the second voltage source;
30 and

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- 5 a voltage-controlled oscillator connected between
 an output end of the differential amplifier and
 an input end of the negative charge pump[[.]]i
 and
 a protection circuit, whose input end and output end are
 connected to the output end of the negative charge pump
 and wells of the PMOS transistors respectively, for
 generating a first protection voltage at the output end
10 of the protection circuit by determining the first output
 voltage.
- 15 2. (original) The regulated charge pump of claim 1, wherein the
 second voltage source is ground.
3. (cancelled)
- 20 4. (currently amended) The regulated charge pump of ~~claim 3~~ claim
 1, wherein the protection circuit comprises:
 a switch, whose first and second ends are connected to the
 output end of the protection circuit and the first
 protection voltage respectively; and
 a voltage detection circuit connected to the switch and to
25 the output end of the negative charge pump for
 controlling the switch by determining the first output
 voltage.
- 30 5. (original) The regulated charge pump of claim 4, wherein when
 the voltage detection circuit detects that the first output

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voltage is lower than a threshold voltage, the switch is closed and transmits the first protection voltage to the wells of the PMOS transistors.

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6-9. (cancelled)

10. (currently amended) A regulated charge ~~pumping~~ pump comprising:

10 a ~~negative~~ positive charge pump for generating a first output voltage by determining an oscillation signal; [[and]] a regulator for restricting a swing of the first output voltage, the regulator comprising:

15 a level shift circuit connected to the ~~negative~~ positive charge pump for generating a second output voltage at an output end of the level shift circuit by determining the first output voltage generated by the ~~negative~~ positive charge pump, the level shift circuit comprising:

20 a plurality of serially connected NMOS transistors, a first source of a first NMOS transistor of the NMOS transistors connected to a first reference voltage source, a first gate and a first drain of the first NMOS transistor connected to the
25 output end of the level shift circuit, and a second gate and a second drain of a second NMOS transistor of the NMOS transistors connected to the output end of the ~~negative~~ positive charge pump;

30 a differential amplifier, whose first and second

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5 input ends are connected to a second reference voltage source and the output end of the level shift circuit respectively, for generating a compare signal by determining a voltage difference between the second output voltage and a voltage generated by the second voltage source; and

10 a voltage-controlled oscillator connected between an output end of the differential amplifier and an input end of the ~~negative~~ positive charge pump[[]] ; and

15 a protection circuit, whose input end and output end are connected to the output end of the positive charge pump and wells of the NMOS transistors respectively, for generating a first protection voltage at the output end of the protection circuit by determining the first output voltage.

20

11. (original) The regulated charge pump of claim 10, wherein the second voltage source is ground.

12. (cancelled)

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13. (currently amended) The regulated charge pump of ~~claim 12~~ claim 10, wherein the protection circuit comprises:

30 a switch, whose first and second ends are connected to the output end of the protection circuit and the first protection voltage respectively; and

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5 a voltage detection circuit connected to the switch and to
the output end of the ~~negative~~ positive charge pump for
controlling the switch by determining the first output
voltage.

10 14. (original) The regulated charge pump of claim 13, wherein
when the voltage detection circuit detects that the first
output voltage is higher than a threshold voltage, the switch
is closed and transmits the first protection voltage to the
wells of the NMOS transistors.

15-18. (cancelled)

15 19. (new) A regulated charge pump comprising:
a negative charge pump for generating a first output voltage
by determining an oscillation signal;
a regulator for restricting a swing of the first output
voltage, the regulator comprising:
20 a level shift circuit connected to the negative charge
pump for generating a second output voltage at an
output end of the level shift circuit by determining
the first output voltage generated by the negative
charge pump, the level shift circuit comprising:
25 a plurality of serially connected PMOS transistors,
a first source of a first PMOS transistor of the
PMOS transistors connected to a first reference
voltage source, a first gate and a first drain
of the first PMOS transistor connected to the
30 output end of the level shift circuit, and a

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- second gate and a second drain of a second PMOS transistor of the PMOS transistors connected to the output end of the negative charge pump;
- 5 a differential amplifier, whose first and second input ends are connected to a second reference voltage source and the output end of the level shift circuit respectively, for generating a compare signal by determining a voltage
- 10 difference between the second output voltage and a voltage generated by the second voltage source; and
- a voltage-controlled oscillator connected between an output end of the differential amplifier and
- 15 an input end of the negative charge pump; and
- a protection circuit, whose input end, first, and second output ends are connected to the output end of the negative charge pump, a first well of the first PMOS transistor, and wells of remaining PMOS transistors
- 20 respectively, for generating first and second protection voltages at first and second output ends of the protection circuit respectively by determining the first output voltage.
- 25 20. (new) The regulated charge pump of claim 19, wherein the second voltage source is ground.
21. (new) The regulated charge pump of claim 19, wherein the first protection voltage is higher than the second protection
- 30 voltage.

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22. (new) The regulated charge pump of claim 19, wherein the protection circuit comprises:

5 a switch, whose first, second, third, and fourth ends are connected to a first output end of the protection circuit, the first protection voltage, a second output end of the protection circuit, and the second protection voltage respectively; and

10 a voltage detection circuit connected to the switch and to the output end of the negative charge pump for controlling the switch by determining the first output voltage.

23. (new) The regulated charge pump of claim 22, wherein when
15 the voltage detection circuit detects that the first output voltage is lower than a threshold voltage, the switch is closed and transmits the first and second protection voltages to the first well of the first PMOS transistor and the wells of the remaining PMOS transistors respectively.

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24. (new) A regulated charge pump comprising:

a positive charge pump for generating a first output voltage by determining an oscillation signal;

25 a regulator for restricting a swing of the first output voltage, the regulator comprising:

30 a level shift circuit connected to the positive charge pump for generating a second output voltage at an output end of the level shift circuit by determining the first output voltage generated by the positive charge pump, the level shift circuit comprising:

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5 a plurality of serially connected NMOS transistors,
a first source of a first NMOS transistor of the
NMOS transistors connected to a first reference
voltage source, a first gate and a first drain
of the first NMOS transistor connected to the
output end of the level shift circuit, and a
second gate and a second drain of a second NMOS
transistor of the NMOS transistors connected to
10 the output end of the positive charge pump;
a differential amplifier, whose first and second
input ends are connected to a second reference
voltage source and the output end of the level
shift circuit respectively, for generating a
15 compare signal by determining a voltage
difference between the second output voltage and
a voltage generated by the second voltage source;
and
a voltage-controlled oscillator connected between
20 an output end of the differential amplifier and
an input end of the positive charge pump; and
a protection circuit, whose input end, first, and second
output ends are connected to the output end of the
positive charge pump, a first well of the first NMOS,
25 and wells of remaining NMOS transistors respectively,
for generating first and second protection voltages at
first and second output ends of the protection circuit
respectively by determining the first output voltage.

30 25. (new) The regulated charge pump of claim 24, wherein the

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second voltage source is ground.

26. (new) The regulated charge pump of claim 24, wherein the first
5 protection voltage is lower than the second protection
voltage.

27. (new) The regulated charge pump of claim 24, wherein the
protection circuit comprises:
10 a switch, whose first, second, third, and fourth ends are
connected to a first output end of the protection circuit,
the first protection voltage, a second output end of the
protection circuit, and the second protection voltage
respectively; and
15 a voltage detection circuit connected to the switch and to
the output end of the positive charge pump for
controlling the switch by determining the first output
voltage.

20 28. (new) The regulated charge pump of claim 27, wherein when
the voltage detection circuit detects that the first output
voltage is higher than a threshold voltage, the switch is
closed and transmits the first and second protection voltages
to the first well of the first NMOS transistor and the wells
25 of the remaining NMOS transistors respectively.